

**PERFORMANCE OF HOT MIX ASPHALT USING PEAT MODIFIED
ASPHALT BINDER**

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DEDICATION

I would like to announce my appreciation to Allah Almighty for his grace, guidance and protection of me during my Ph.D. study.

Specially Dedicated to

My Parents

My Lovely Brothers and Sisters

My love to you will always remain and thank you for your Support, Guidance, Patience, Joyfulness to make this experience complete.

Thank you for your Sacrifices, Prayers, Understanding, and Continuous Support

I Wouldn't Make it Without you.

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“May ALLAH Bless Us All To Achieve Excellence in Life”

ABSTRACT

In recent years, the road distresses have caused millions of ringgit to maintenance cost. Hence, allowed paving technologists to examine the benefits of introducing additives and modifiers. As a result modifiers such as fillers, extenders polymers (natural and synthetic), fibers among others, are introduced to be mixed with asphalt. This study was conducted to investigate the use of parit Nipah peat (PNpt) to be mixed with asphalt, both of unaged and aged conditions to improve the performance of asphalt mix. The physical properties, storage stability and rheological properties of base asphalt and PNpt modified asphalt (PNpt.M.A.) were measured. It was observed that the rheological properties differ considerably between the base asphalt and PNpt. The rheological changes associated with the ageing of PNpt.M.A are linked to a breakdown of the molecular structure of the binders to form a lower molecular weight peat substructure. Based on the SHRP rutting parameters, adding PNpt decreases rutting for the binder at high temperature rheological properties indicated that 5% PNpt or PNpt.M.A. 5 is the optimum content as a modifier with asphalt. After the optimum content of PNpt, tests were conducted to investigate the performance characteristics, where the mixes were prepared according to the wet process. Mechanical testing on the PNpt asphalt mixes have demonstrated that the asphalt mix stiffness, rutting performance at high temperature were found to be improved. Modification indices with the PNpt 5% showing a peak modification with 45.6% percentages increasing to enhancement towards against rutting deformations with consideration the effect of aging as an average of the mixture work interim of rutting resistance. However, the durability studies have indicated that PNpt are slightly susceptible with the presence of rutting. The stiffness modules of mixes were found to be affected by the testing temperatures and frequencies. As conclusion, asphalt pavement performance can be enhanced by using PNpt as modifier is major road distresses. In addition, it has the excellent potential for great modification of the asphalt binder and mixture.

ABSTRAK

Sejak kebelakangan ini, peningkatan trafik serta tekanan tayar, trak yang besar dan berat dan rekabentuk gandar baru menyebabkan menyebabkan kos jutaan ringgit untuk penyelenggaraan. Oleh itu, pemahaman yang lebih baik tentang tingkah laku dan sifat asphalt, juga dengan perkembangan teknologi, membolehkan teknologis mengkaji manfaat dalam memperkenalkan bahan tambah dan bahan pengubahsuaian. Bahan pengubahsuaian seperti bahan pengisi, polimer (semulajadi dan sintetik) dan fiber diperkenalkan untuk dicampurkan dengan asphalt agar dapat meningkatkan ciri-ciri asphalt sebagai bahan pengikat. Kajian ini dijalankan bagi mengkaji penggunaan partikel tanah gambut Parit Nipah (PNpt) untuk dicampur dengan asphalt bagi kedua-dua keadaan iaitu tanpa rawatan dan kajian jangka pendek bertujuan untuk meningkatkan prestasi campuran asphalt. Ciri-ciri fizikal, kestabilan penyimpanan dan rheologi bagi asphalt asas dan asphalt PNpt yang diubahsuaikan (PNpt.M.A.) juga diukur. Parameter asas digunakan untuk menggambarkan kepentingan PNpt sebagai bahan pengubah. Didapati bahawa kestabilan penyimpanan bergantung kepada kandungan bahan yang terdapat dalam asphalt tersebut. Bagaimanapun, pemerhatian mendapati bahawa sifat rheologi jauh berbeza antara asphalt asas dan PNpt. Perubahan rheologi berkait dengan penuaan PNpt.M.A. dikaitkan dengan pecahan struktur molekul pengikat untuk membentuk substruktur molekul gambut yang lebih rendah. Ini mengakibatkan peningkatan tingkah laku selepas penuaan berbanding peningkatan tingkah laku keanjalan di dalam asphalt asas. Berdasarkan parameter kegagalan permukaan jalan disebabkan oleh kesan roda SHRP, penambahan PNpt mengurangkan kegagalan permukaan jalan disebabkan oleh kesan roda pada suhu tinggi sifat rheologi menunjukkan bahawa 5% PNpt atau PNpt.M.A. 5 ialah kandungan optimum sebagai bahan pengubah suai asphalt. Selepas mendapatkan kandungan PNpt yang optimum, ujian telah dijalankan untuk mengkaji ciri-ciri prestasi campuran asphalt PNpt, di mana campuran telah disediakan mengikut

proses basah. Ujian mekanikal terhadap campuran asphalt PNpt telah menunjukkan bahawa ciri kekerasan campuran asphalt, prestasi bagi kegagalan permukaan jalan disebabkan oleh kesan roda pada suhu tinggi didapati bertambah baik berbanding dengan asphalt asas PNpt.MA 0. Bagaimanapun, kajian ketahanan telah menunjukkan bahawa PNpt mudah terdedah dengan kehadiran kegagalan permukaan jalan disebabkan oleh kesan roda. Kajian ketahanan juga dilakukan untuk mengkaji sifat penuaan jangka masa pendek bagi PNpt. Didapati bahawa ciri kekerasan bagi campuran asphalt meningkat disebabkan kesan gabungan di antara penuaan jangka masa pendek bagi campuran asphalt. Modulus ciri kekerasan campuran didapati terjejas oleh ujian suhu dan frekuensi. Kesimpulannya, prestasi turapan asphalt boleh ditingkatkan dengan menggunakan PNpt sebagai bahan pengubah suai bagi masalah jalan utama. Di samping itu, terdapat potensi yang sangat baik untuk pengubahsuaian bahan pengikat dan campuran asphalt.

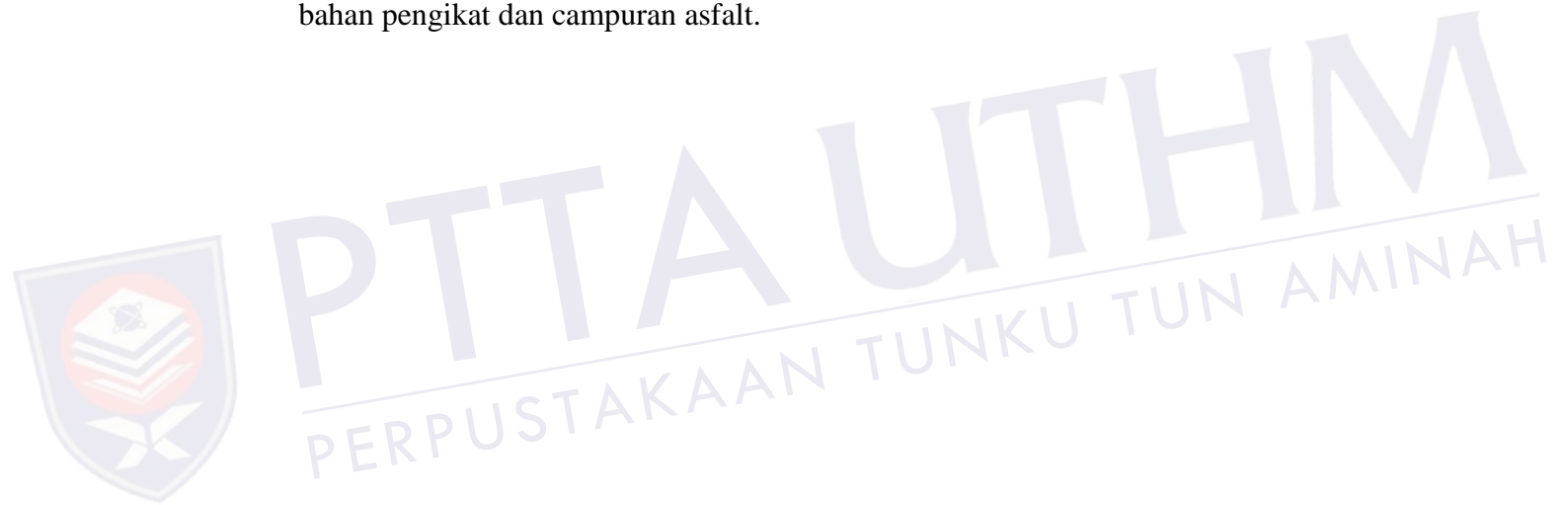


TABLE OF CONTENTS

TITTLE	i
STUDENT’S DECLARATION	Error! Bookmark not defined.
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
ABSTRAK	vi
TABLE OF CONTENTS	viii
LIST OF TABLES	xv
LIST OF FIGURES	xx
LIST OF ABBREVIATIONS	xxiv
LIST OF SYMBOLS	xxvi
LIST OF APPENDICES	xxviii
CHAPTER 1 INTRODUCTION	1
1.1 Preamble	1
1.2 Problem statement	2
1.3 Aim and objectives	4
1.4 Scope of study	5
1.5 Importance of study	5
1.6 Thesis structure	6
CHAPTER 2 LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Asphalt binder	9

2.2.1 Asphalt chemical characterization	11
2.2.2 Asphalt physical characterization	13
2.2.3 Rheological properties of asphalt	13
2.2.4 Experimental for characterizations of asphalt	15
2.2.4.1 Dynamic Shear Rheometer (DSR)	16
2.2.4.2 Time-temperature superposition principle	19
2.2.4.3 Master curve	20
2.2.4.4 Isochronal plot	21
2.2.4.5 Black diagram plot	21
2.2.4.6 SHRP parameters	22
2.2.4.7 Fourier transform infrared spectroscopy	23
2.2.4.8 Scanning Electron Microscopy (SEM)	23
2.2.4.9 Asphalt aging	24
2.3 Parit nipah peat (PNpt)	25
2.3.1 Utilization and ranked of peat	26
2.3.2 Properties of peat	27
2.4 Preparation technology of modified asphalts	29
2.5 Application of modified asphalt in road constrictions	30
2.5.1 Introduction and definition	30
2.5.2 Clay modified asphalt	31
2.5.3 Silica modified asphalt	35
2.5.4 Titanium dioxide and silicon dioxide $\text{TiO}_2/\text{SiO}_2$	37
2.5.5 Performance of different types of modifies asphalt	38
2.6 Hot Mix Asphalt (HMA)	41
2.6.1 Hot mix asphalt technology	42
2.6.2 Effect of modifier asphalt in permanent deformation	433
2.6.3 Effect of modified asphalt on mechanical properties	46
2.6.4 Superpave gradation and effects on rutting	48
2.6.5 Requirements design for superpave design method	48
2.6.6 Evolution of modified asphalt in hot-mix asphalt	50

2.6.7 Effect of modified asphalt on aging of asphaltic mixture	54
2.7 Mechanical tests for characterization of asphaltic mixture	57
2.7.1 Resilient modulus	57
2.7.2 Repeated load permanent deformation test (flow number test)	58
2.8 Rutting assessment	59
2.8.1 Rutting criteria	62
2.8.2 Types of rutting	63
2.8.2.1 Rutting by densification (vertical compression)	63
2.8.2.2 Rutting by ravelling	64
2.8.2.3 Rutting by shoving	64
2.8.2.4 Mixture properties that influence rutting resistance	65
2.8.3 Causes of rutting	66
2.8.4 Factors influence rutting	66
2.9 Summary of chapter	68
CHAPTER 3 RESEARCH METHODOLOGY	71
3.1 Introduction	71
3.2 Process research framework	71
3.3 Experimental process and materials	73
3.4 Material collection	73
3.5 Asphalt	73
3.5.1 Binder preparation	74
3.5.2 Asphalt modification (blending)	74
3.6 Conventional physical properties	76
3.6.1 Penetration	76
3.6.2 Ring and ball softening point test	77
3.6.3 Rotational Viscometer (RV) test	77
3.6.4 Ductility test	78
3.6.5 Loss in heating	79

3.6.6 Flash point and fire point	80
3.6.7 Storage stability	80
3.6.8 Temperature susceptibility	81
3.7 Important characterise of asphalt binder	82
3.7.1 Aging method for asphalt binder	82
3.7.2 Dynamic shear rheometer	83
3.7.3 Fourier transform infrared spectroscopy	85
3.7.4 Surface free energy	86
3.7.5 Surface Morphology by Scanning Electron Microscopy (SEM)	86
3.7.6 X-ray Diffraction (XRD) analysis	87
3.8 Superpave method for asphalt mix design	88
3.8.1 Aggregate for asphalt mixture	89
3.8.2 Sieve analysis	90
3.8.3 Specimen preparation	91
3.8.4 Specimen compaction	91
3.8.5 Optimum Asphalt Content (OAC)	92
3.8.6 Mixture volumetric evaluation	92
3.9 Volumetric properties of asphalt mixture	95
3.9.1 Maximum specific gravity (<i>G_{mm}</i> CoreLok)	95
3.10 Performance of hot mix asphalt testes	95
3.10.1 Indirect tensile modulus test	96
3.10.2 Creep test	97
3.10.2.1 Static creep test	97
3.10.2.2 Dynamic creep test	97
3.10.3 Wheel-tracking test	98
3.11 Statistical analysis	99
3.12 Summary of chapter	100

CHAPTER 4 PERFORMANCE OF CHEMICAL, PHYSICAL AND RHEOLOGICAL PROPERTIES OF ASPHALT BINDER

4.1 Introduction to chapter	101
4.2 Properties of the materials	102

4.2.1 Asphalt binder	102
4.2.2 Parit Nipah Peat (PNpt)	102
4.2.3 Blending process	104
4.2.4 Point of homogeneity	104
4.3 Chemical properties of the materials	106
4.3.1 Characterization of PNpt.M.A by Scanning Electron Microscopic (SEM)	107
4.3.2 Electron images of unmodified	107
4.3.3 Electron images of PNpt modified asphalt binder	108
4.3.4 Fourier transform infrared spectroscopy	110
4.3.5 Surface free energy	112
4.3.6 X-Ray Diffraction (XRD)	115
4.4 Results of physical tests	116
4.4.1 Penetration	116
4.4.2 Softening point ring and ball	118
4.4.3 Loss on heating	120
4.4.4 Ductility test	121
4.4.5 Viscosity	123
4.4.6 Flash point and fire point	125
4.4.7 Storage stability	125
4.4.8 Temperature susceptibility	127
4.5 Physical Properties of aged index	128
4.5.1 Penetration aging index	128
4.5.2 Softening point aging index	129
4.5.3 Viscosity aging index	131
4.6 Results of rheological tests	132
4.6.1 Effect of PNpt.M.A on ' G^* ' and ' δ ' (unaged and short-term)	132
4.6.2 Rutting parameter SHRP ($G^*/\sin \delta$) (unaged and short-term)	137
4.6.3 Isochronal plot	144
4.6.4 Rheological master curves (unaged)	147
4.6.5 Rheological master curves (short-tem)	150
4.6.6 Black diagram (unaged)	152

4.6.7 Black diagram (short-term)	153
4.6.8 Failure temperature	154
4.6.9 Creep and recovery (unaged)	155
4.6.10 Creep and recovery (short-term)	158
4.6.11 Multiple stress creep recovery (unaged)	160
4.6.12 Multiple stress creep recovery (shot-term)	163
4.7 Summary of chapter	166

CHAPTER 5 PERFORMANCE OF ASPHALTIC MIXTURE

MODIFIED BY PARIT NIPAH PEAT 168

5.1 Introduction	168
5.2 Properties of peat modified asphalt mixture	169
5.3 The Design of aggregates	169
5.3.1 Flakiness and elongation	171
5.3.2 Aggregate Impact Value (AIV)	172
5.3.3 Specific gravity results	173
5.4 Determination of volumetric properties of asphalt mixes	173
5.5 Evaluation of modified asphaltic mixture	175
5.5.1 Resilient modulus test	176
5.5.2 Static creep test	182
5.5.3 Dynamic creep	188
5.5.4 Wheel tracking	192
5.6 Establishment of relationship between asphalt mixtures Performances and asphalt binders performances	197
5.6.1 Relationship of asphalt mixture performance tests and Viscosity of asphalt binders	198
5.6.2 Relationship of asphalt mixture performance tests and $G^*/\sin \delta$ of asphalt binders	200
5.6.3 Relationship of asphalt mixture creep tests and creep recovery of asphalt binders	202
5.6.3.1 Creep and creep recovery	203
5.6.3.2 Multiple stress creep recovery	204
5.7 Summary of chapter	207

CHAPTER 6 CONCLUSION AND RECOMMENDATIONS	208
6.1 Conclusion	208
6.2 Recommendations	210
REFERENCES	212
APPENDICES	227
LIST OF PUBLICATIONS	297
VITA	



LIST OF TABLES

2.1	Elemental composition of asphalt binder	12
2.2	Superpave asphalt binder testing equipment and purposes	15
2.3	Placement and compaction temperature for HMA	20
2.4	Some common types of asphalt modifiers	41
2.5	Rutting criteria	63
2.6	Factors influencing rutting of asphalt mixtures	67
2.7	Gap of study from several papers and journals of enhance asphalt properties	68
3.1	Binder identity and composition matrix	74
3.2	Blending binders protocol	75
3.3	Acceptable difference for penetration results	76
3.4	Correction factors volatilization ratio	80
3.5	Gradation limit for ASTM D 3515-96 (D-4)	90
3.6	Superpave gradation requirement for restricted zone	91
3.7	Superpave gyratory compactor effort based on esals	91
3.8	Design mix criteria	92
3.9	The indirect tensile resilient modulus parameters	96
3.10	The parameters of dynamic creep test	97
3.11	The parameters of wheel-tracking	99
4.1	Materials properties for the base asphalt	102
4.2	Physical properties of peat	103
4.3	Parameters in blending procedure	104
4.4	Optimum blending time (point of homogeneity)	105
4.5	Statistical analysis of optimum blending time	105

4.6	ZAF method standard less quantitative analysis with fitting coefficient 0.4600	107
4.7	ZAF method standard less quantitative analysis with fitting coefficient 0.5473	109
4.8	Functional groups containing a carbonyl in the asphalt binder	111
4.9	Comparison of significant difference of surface energy	114
4.10	Comparison of significant difference of penetration test	118
4.12	Post hoc multiple comparisons between base and pnpt modified asphalt binder	118
4.13	Comparison of significant difference level of softening point	119
4.14	Post hoc multiple comparisons between base and pnpt modified asphalt binder	120
4.14	Results mass change after heating of binders	120
4.15	Comparison of significant difference level of loss in heating	121
4.16	Post hoc multiple comparisons between base and pnpt modified asphalt binder	121
4.17	Results of binders on ductility test	122
4.18	Comparison of significant difference level of ductility test	122
4.19	Post hoc multiple comparisons between base and pnpt modified asphalt binder	123
4.20	Comparison of significant difference level of viscosity test	124
4.21	Post hoc multiple comparisons between base and pnpt modified asphalt binder	125
4.22	The result of the flash point and fire point	125
4.23	Results for storage stability test	127
4.24	Comparison of significant difference level of storage stability	127
4.25	The results of PI and PVN for base and PNpt modified asphalt binder	128
4.26	Ageing index of penetration test	129
4.27	Aging index of softening point ring and ball test	130
4.28	The viscosity aging index	131

4.29	Comparison of significant difference level of complex modulus 'G*'	135
4.30	Post hoc multiple comparisons between base and pnpt modified asphalt binder	135
4.31	Comparison of significant difference level of complex modulus 'G*'	137
4.32	Post hoc multiple comparisons between base and pnpt modified asphalt binder	137
4.33	DSR test results with binder grades	138
4.34	Comparison of significant difference levels of rutting parameter ($G^*/\sin \Delta$)	143
4.35	Post hoc multiple comparisons between base and pnpt modified asphalt binder	144
4.37	Comparison of significant difference levels of complex modulus G* master curve unaged	149
4.38	Post hoc multiple comparisons between base and PNPT modified asphalt binder	150
4.38	Comparison Of significant difference levels of complex modulus G* master curve short term	152
4.39	Post hoc multiple comparisons between base and pnpt modified asphalt binder	152
4.40	Comparison of significant difference levels of creep and recovery	157
4.42	Post hoc multiple comparisons between base and pnpt modified asphalt binder	157
4.42	Comparison of significant difference levels of creep and recovery short term	159
4.43	Post hoc multiple comparisons between base and PNpt modified asphalt binder	160
4.44	Comparison of significant difference levels of multi creep and recovery unaged	163

4.45	Post hoc multiple comparisons between base and PNpt modified asphalt binder	163
4.46	Comparison of significant difference levels of multi creep and recovery short term	165
4.47	Post hoc multiple comparisons between base and PNpt modified asphalt binder	166
5.1	Designed aggregate structure	170
5.2	Results of aggregate properties	171
5.3	Summary of flakiness test	171
5.4	Summary of elongation test	172
5.5	Summary of aggregate impact value test	172
5.6	Bulk specific gravity of aggregates	173
5.7	Optimum asphalt contents and met the superpave criteria of PNpt.M.A	175
5.8	Resilient modulus of unaged at 25°C and 40°C	177
5.9	Resilient modulus of short term At 25°C and 40°C	179
5.10	Aging index of asphalt mixture and PNpt modified asphalt	180
5.11	Comparison of significant difference levels of resilient modulus unaged 25°C and 40 °C	181
5.12	Post hoc multiple comparison between base and PNpt modified	181
5.13	Comparison of significant difference levels of resilient modulus short term 25°C and 40 °C	181
5.14	Post hoc multiple comparison between base and PNpt modified	182
5.15	Comparison between the control and modified mixtures for maximum permanent deformation and axial strain in static creep test	183
5.16	Ageing index for static creep	187
5.17	Comparison of significant difference levels of static creep unaged	187
5.18	Post hoc multiple comparisons between base and PNpt modified asphalt binder	187

5.19	Comparison of significant difference levels of static creep short term	188
5.20	Post hoc multiple comparisons between base and PNpt modified asphalt binder	188
5.21	Ageing index for dynamic creep test 40°C	191
5.22	Comparison of significant difference levels of dynamic creep unaged	191
5.23	Post hoc multiple comparisons between base and PNpt modified asphalt binder	192
5.24	Comparison of significant difference levels of dynamic creep short term	192
5.25	Post hoc multiple comparisons between base and PNpt modified asphalt binder	192
5.26	Ageing index for wheel tracking test at 45°C	196
5.27	Comparison of significant difference levels of wheel tracking unaged	196
5.28	Post hoc multiple comparisons between base and PNpt modified asphalt binder	196
5.29	Comparison of significant difference levels wheel tracking short term	197
5.30	Post hoc multiple comparisons between base and PNpt modified asphalt binder	197
5.31	Criteria for goodness of fit statistical parameters	198

LIST OF FIGURES

1.1	Rutting in asphalt pavement	4
2.1	Schematic of the chemical composition of asphalt	11
2.2	Stress-strain response of a viscoelastic material	17
2.3	Classification of asphalt mixtures based on production temperature	20
2.4	The SEM image and FTIR spectra of carbon microfiber and nanomer	31
2.5	FE-SEM microstructure images of polymer modified nano clay and PMN modified asphalt binder	32
2.6	SEM image of nano-clay	34
2.7	Failure zones under tire load	44
2.8	Permanent deformation	45
2.9	Aging of asphalt during mixing, storage, transportation, application and in service	56
2.10	Typical relationship between permanent strain and number of cycle in flow number test	58
2.11	Rutting in asphalt pavement	60
2.12	Stress and strain of permanent deformation	61
2.13	Characterization of downward and total rutting	63
3.1	Flow chart	72
3.2	Asphalt binder	73
3.3	Blending procedure	75
3.4	Ring and ball softening point test device	77
3.5	Ductility test device	79
3.6	Equipment of loss in heating test	80
3.7	Aluminum foils tube	81

3.8	Rolling thin film oven test set up	83
3.9	Dynamic shear rheometer	83
3.10	Schematic of dsr testing arrangement	84
3.11	Used to determine linear viscoelastic region	84
3.12	Fourier transform infrared spectroscopy device	86
3.13	Scanning electron microscopy (SEM) device	87
3.14	Specimens coating device	87
3.15	Superpave gyratory compactor	89
3.16	Universal testing machine 25	96
3.17	Wheel-tracking test	98
4.1	Parit nipah peat (PNpt) balls and particles	103
4.2	Optimum blending time	105
4.3	Plot of predicted values versus actual of optimum blending time	106
4.4	Electron images of unmodified for one magnification 500x	107
4.5	Electron images of modified for one magnification 500x	108
4.6	Electron images of PNpt for differences magnifications: (a) 100 x ; (b) 200 x; (c) 500 x; (d) 1000 x;	109
4.7	FTIR spectra of base asphalt and PNpt.M.A	111
4.8	Carbony indexes from FTIR test	112
4.9	Sulphoxide indexes from FTIR test	112
4.10	Connecting angle the surface of PNpt.M.A	113
4.11	Surface energy of unaged asphalt binder	113
4.12	XRD patterns of base asphalt binder and PNpt modified asphalt	116
4.13	Results of penetration at 25°C	117
4.14	The result softening point ring and ball	119
4.15	The result of viscosity	124
4.16	Aluminium tube for storage stability test	126
4.17	Penetration ageing index	129
4.18	Softening point values after aging	130
4.19	Viscosity values for unaged and short-term at 135°C	131
4.20	Effect of PNpt.M.A on complex modulus 'G*' and phase angle 'δ' of unaged binders	134
4.21	Effect of PNpt.M.A on complex modulus 'G*' and phase angle 'δ' of short-term binders	136

4.22	Comparing PNpt effect on ' $G^*/\sin\delta$ ' value from DSR test at 40 °C	139
4.23	Comparing PNpt effect on ' $G^*/\sin\delta$ ' value from DSR test at 58 °C	140
4.24	Comparing PNpt effect on ' $G^*/\sin\delta$ ' value at 64 °C	141
4.25	Comparing PNpt effect on ' $G^*/\sin\delta$ ' value at 70 °C	141
4.26	Effect of PNpt.M.A on ' $G^*/\sin\delta$ ' values for unaged and short-term	143
4.27	Isochronal plots of the complex modulus G^* at 1 Rad	145
4.28	Isochronal plots of the complex modulus G^* at 10 Rad	145
4.29	Modification indices for complex modulus G^* at 1 Rad	146
4.30	Modification indices for complex modulus G^* at 10 Rad	147
4.3	Complex modulus master curves for base and PNpt modified asphalt binder at the reference temperature of 45 °C	148
4.32	Phase angle master curves for base and PNpt modified asphalt binder at the reference temperature of 45 °C	149
4.33	Complex modulus master curves for short-term base and PNpt modified asphalt binder at the reference temperature of 45 °C	151
4.34	Phase angle master curves for short-term base and PNpt modified asphalt binder at the reference temperature of 45 °C	151
4.35	Black diagrams for base and PNpt modified asphalt binder	153
4.36	Black diagrams for base and PNpt modified asphalt binder	154
4.37	Failure temperatures for base and PNpt modified asphalt binder	155
4.38	Compliance creep and recovery at 3Pa	156
4.39	Compliance creep and recovery at 10Pa	156
4.40	Compliance creep and recovery at 50Pa	157
4.41	Creep and recovery of short-term at 3Pa	158
4.42	Creep and recovery of short-term at 10Pa	158
4.43	Creep and recovery of short-term at 50Pa	159
4.44	Compliance creep at 64°C for unaged (100 Pa)	162
4.45	Compliance creep at 64°C for unaged (3200 Pa)	162
4.46	Compliance creep at 64°C for s-t (100 Pa)	164
4.47	Compliance creep at 64°C for s-t (3200 Pa)	165
5.1	Aggregate gradation for 19mm nms on 0.45 powers chart	170
5.2	Resilient modulus of unaged at 25°C	178

5.3	Resilient modulus of unaged at 40°C	178
5.4	Resilient modulus of short term at 25°C	179
5.5	Resilient modulus of short term at 40°C	180
5.6	Axial strains of the mixtures with different ratios of PNpt in static creep behaviour	184
5.7	Permanent deformation of the mixtures with different ratios of PNpt in static creep behaviour	184
5.8	Axial strains of the short term mixtures with different ratios of PNpt in static creep behavior	185
5.9	Permanent deformation of the mixtures with different ratios of PNpt in static creep behavior	186
5.10	Dynamic creep of unaged at 40°C	189
5.11	Dynamic creep of short-term aged at 40°C	190
5.12	Wheel tracking results of unaged	194
5.13	Wheel tracking results of short-term aged	195
5.14	Correlations between MR and VR	199
5.15	Correlations between static creep and VR	199
5.16	Correlations between dynamic creep and VR	199
5.17	Correlations between wheel tracking and VR	200
5.18	Correlations between MR and $G^*/\sin \delta$	201
5.19	Correlations between static creep and $G^*/\sin \delta$	201
5.20	Correlations between dynamic creep and $G^*/\sin \delta$	202
5.21	Correlations between wheel tracking and $G^*/\sin \delta$	202
5.22	Correlations between MR and creep and recovery	203
5.23	Correlations between static creep and creep recovery	203
5.24	Correlations between dynamic creep and creep recovery	204
5.25	Correlations between wheel tracking and creep recovery	204
5.26	Correlations between mr and multiple stress creep recovery	205
5.27	Correlations between static creep and multiple stress creep recovery	205
5.28	Correlations between dynamic creep and multiple stress creep recovery	205
5.29	Correlations between wheel tracking and multiple stress creep recovery	206

LIST OF ABBREVIATIONS

A	-	Aging
AI	-	Aging Index
AI	-	Asphalt Institute
AASHTO	-	American association of state highway and transportation officials
ASTM	-	American society for testing and materials
ANOVA	-	Analysis of Variance
AC	-	Aging Condition
BT	-	Asphalt Binder Type
CGN	-	Compaction Gyrations Number
DSR	-	Dynamic Shear Rheometer
DG	-	Dense-Grade
ESALs	-	Equivalent Single Axle Loads
G_{sb}	-	Bulk Specific Gravity of Aggregate
G_b	-	Specific Gravity of Asphalt
G_{se}	-	Effective Specific Gravity of Aggregate
G_{mb}	-	Specific Gravity of Aggregate
G_{mm}	-	Maximum Specific Gravity of Paving Mixture
HMA	-	Hot Mixture Asphalt
ITS	-	Indirect Tensile Strength
MSCR	-	Multiple Stress Creep Recovery
MT	-	Mixing Temperature

$N_{initial}$	-	Compaction Parameter
N_{design}	-	Compaction Parameter
$N_{maximum}$	-	Compaction Parameter
NAPA	-	National Asphalt Pavement Association
SHRP	-	Strategy Highway Research Program
OAC	-	Optimum Asphalt Content
P_{be}	-	Effective Asphalt Content, percent by total weight of Mixture
PAV	-	Pressure Aging Vessel
P_b	-	Asphalt. Percent by total weight of mixture
PNpt	-	Parit Nipah Peat
PNpt.M.A	-	Parit Nipah Peat Modified Asphalt
PG	-	Performance Grade
RTFO	-	Rolling Thin Film Oven
RV	-	Rotational Viscometer
SMA	-	Stone Matrix Asphalt
SFE	-	Surface Free Energy
STA	-	Short-Term-Aging
SGC	-	Superpave Gyratory Compactor
TSR	-	Tensile Strength Ratio
UTM	-	Universal Testing Machine
VFA	-	Voids Filled Asphalt
VMA	-	Voids Mineral Aggregate
VTM	-	Voids in Total Mixture

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